United States Patent [19]

Opocensky

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[54] **CURSOR POSITION DEVICE**

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[73] Assignee: **Xerox Corporation,** Stamford, Conn.

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[21] Appl. No.: **532,788**

[52] **U.S. Cl.** ..... **74/471 R;** 74/198; 340/324 A

[51] **Int. Cl.**[2] **G05G 9/00**

[58] **Field of Search** ..... 74/198, 471; 340/324 A; 178/18–20

[56] **References Cited**

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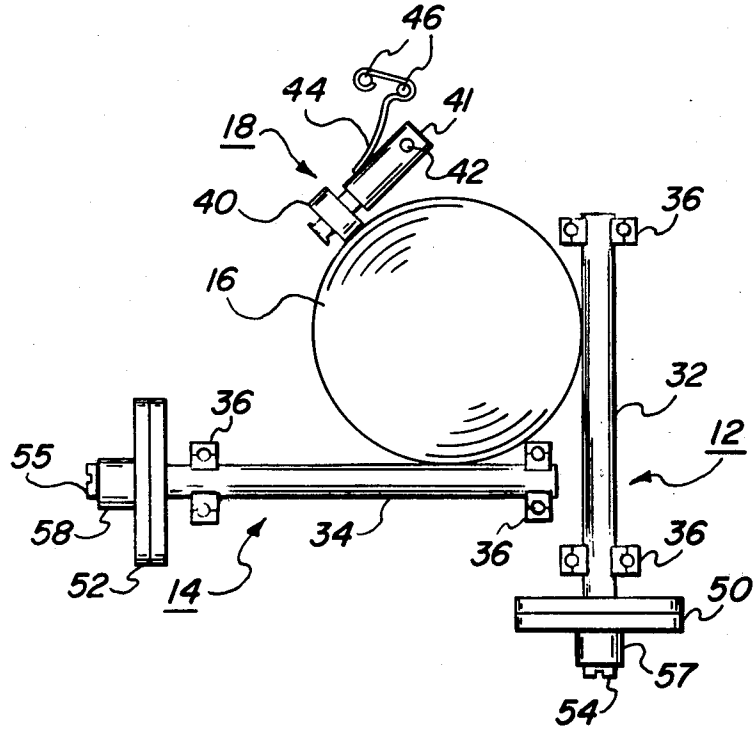
Assistant Examiner—Randall Heald
Attorney, Agent, or Firm—J. E. Beck; T. J. Anderson; L. Zalman

[57] **ABSTRACT**

The invention relates to a position device which rides over a surface for controlling a cursor over a visual display. The device generates signals indicative of its position to cause the cursor to be displayed on the display at a corresponding position. The device includes a control mechanism that comprises a transport sphere coupled with rotatable shafts which represent the position of the device in terms of Cartesian coordinates. The sphere is in contact with the surface over which the device rides and the rotatable shafts contact the sphere at a position on the sphere approximately 90° from the contact loci of the sphere and the surface.

5 Claims, 7 Drawing Figures



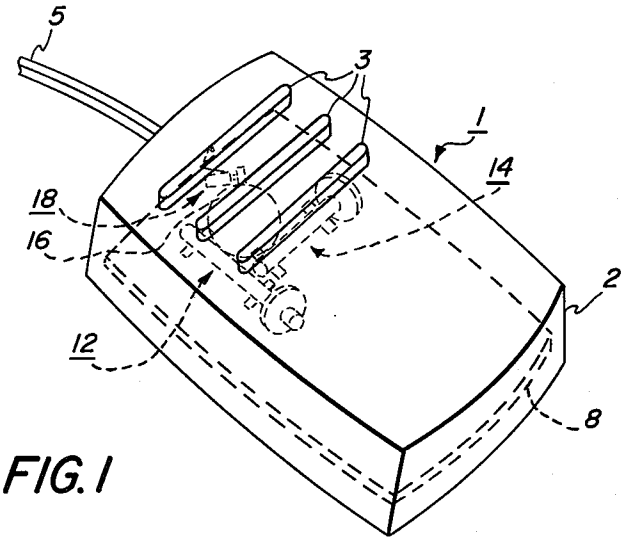


FIG. 1

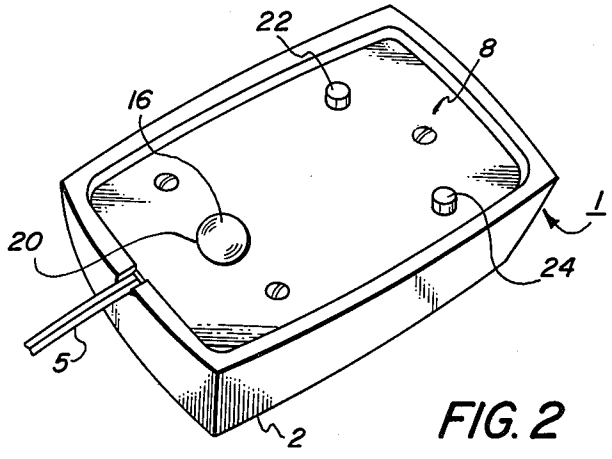
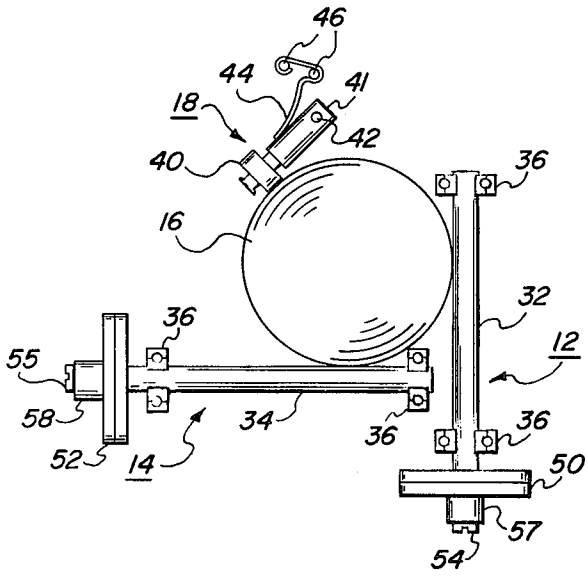


FIG. 2


46
44
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18
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16
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12
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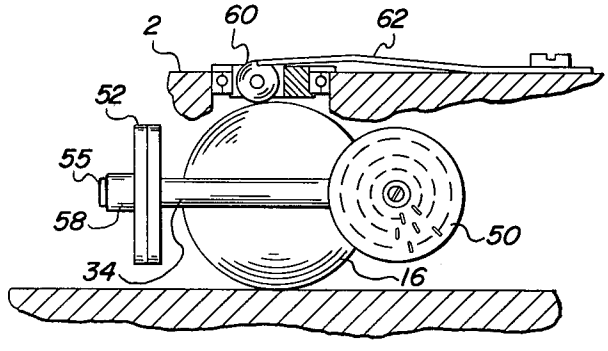
FIG. 3


2
60
62
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55
58
50
34
16

FIG. 4

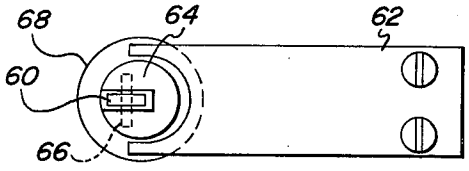

FIG. 5(a)

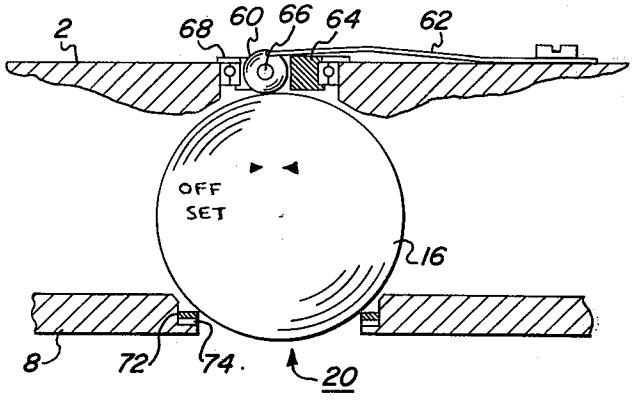

FIG. 5(b)

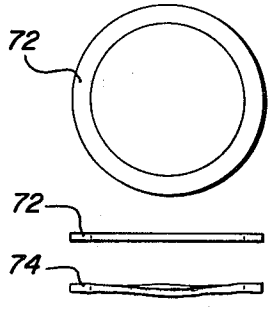

FIG. 5(c)

CURSOR POSITION DEVICE

BACKGROUND OF THE INVENTION

This invention relates to display systems and, more particularly, to devices which alter the display at selected locations by controlling a cursor over the display.

Engelbart, in U.S. Pat. No. 3,541,541 describes an X–Y position indicator control for movement by the hand over any surface to move a cursor over the display on a cathode ray tube. The indicator control mechanism of the Engelbart device contains X and Y position wheels mounted perpendicular to each other, which rotate according to the X and Y movements of the mechanism, and which operate rheostats to send signals along a wire to a computer which controls a CRT display.

The Engelbart device is a promising one for altering a display pattern on a cathode ray tube. The use of the cursor allows the operator to accurately indicate the exact position on the display on which he can make alterations. The X–Y position indicating device is a practicable mechanism for controlling the position of the cursor relative to the display pattern.

A disadvantage of the Engelbart device is that its movement over a surface is dependent upon the movement of the X–Y position wheels themselves. Hence, the device is biased to move in X and Y directions respective to the planes of the X and Y position wheels.

Rider, in U.S. Pat. No. 3,835,464, provides an X–Y position indicator for controlling a cursor over a visual display which is not biased in any given direction of movement. The position indicator includes a transport sphere in combination with position wheels for supporting the indicator and translating its movement into Cartesian coordinates.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide another position device of the type which has as a transport and control element a sphere for removing biases in any given direction of movement.

It is a further object of the present invention to provide a position device for controlling a cursor over a visual display which includes a control mechanism that has as its transport means a sphere capable of rotation in any given direction.

It is yet another object of the present invention to provide a position device which may ride over any surface for controlling a cursor over a visual display.

It is still another object of the present invention to provide a position device for controlling a cursor over a visual display which has a control mechanism that comprises a transport sphere in combination with rotatable shafts ensuring no preferred direction of movement.

Other objects of the present invention will be evident from the description hereinafter presented.

SUMMARY OF THE INVENTION

The invention provides a position device for controlling a cursor over a display on a cathode ray tube. The device generates signals indicative of its position to cause the cursor to be displayed on the CRT at a corresponding position.

Another feature of the invention is that the position device rides over a surface about a transport sphere.

The movement of the transport sphere causes signals to be generated from the device indicative of its position.

Yet another feature of the present invention is that the control mechanism further includes rotatable shafts in combination with the transport sphere such that the shafts contact this sphere at positions on the sphere 90° from the contact locii of the sphere and the supporting surface. The movement of the device over the surface is translated into the movement of the sphere in rotation about its radius. The radial rotation of the sphere is in turn translated into Cartesian coordinates respective to the resulting rotation of the shafts.

An additional feature of the present invention is that the shafts contact the sphere at points on the sphere approximately 90° from each other.

It is still another feature of the invention that the position wheels are coupled to indicating means which transmit X and Y signals which control the display in accordance with the respective movements of the shafts.

It is yet another feature of the invention that a roller be spring loaded to contact the sphere at a third point to constrain the sphere in contact with the rotatable shafts. The third point of contact is preferably at a position on the sphere 90° from the contact locii of the sphere and its supporting surface, opposite from the positions of shaft contact with the sphere, and approximately equidistant therefrom.

Another feature of the present invention is that the sphere is also constrained in an upward direction from its supporting surface by means of another roller spring biased in contact with the sphere opposite from the supporting surface. This point of contact is at a position off-set from a polar position defined on the surface of the sphere by an axis through the center of the sphere and its point of contact with its supporting surface.

These and other features which are considered to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, as well as additional objects and advantages thereof, will best be understood from the following description when considered in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top perspective view of a position device of the present invention.

FIG. 2 is a bottom perspective view of the position device of FIG. 1.

FIG. 3 is a bottom view of the transport sphere shown in FIGS. 1 and 2 as constrained by the rotatable elements in contact with it.

FIG. 4 is a front perspective view of the rotatable shafts shown in FIG. 3 in contact with the sphere riding over a support surface with an additional constraint imposed on the upper surface of the sphere.

FIG. 5(*a*) is a top view of the assembly showing roller and spring.

In FIG. 5(*b*) is shown the upper and lower constraining elements imposed on the sphere by the position device of FIG. 1.

FIG. 5(*c*) is a view of the washers.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 is shown a position device 1 which incorporates features of the invention. Located in the top of the housing 2 of the device 1 are control buttons 3

which are provided for closing switches (not shown) which send pulses through a cable **5** to signal certain changes in the displayed information on a display monitor (not shown). A horizontal support plane **8** is mounted in fixed relation to the inside of the housing **2** to support transducer elements **12** and **14.** A sphere **16** is located within the position device **1** bounded by the transducer elements **12** and **14.** The sphere **16** is constrained against these elements by means of a biasing element **18.**

As shown in FIG. **2,** the sphere **16** protrudes through an aperture **20** to extend beyond the bottom surface of the support plane **8.** Support stems **22** and **24** are mounted on the bottom side of the plane **8** which in combination with a sphere **16** enable the position device **1** to be supported on a surface, such as a table, in a tripodal configuration. The radius of the sphere **16** and the length of the stems **22** and **24** are selected such that the position device **1** is in horizontal relationship with a horizontal supporting surface. As the indicator device **1** is moved by the supporting surface, the sphere **16** translates the *x* and *y* coordinate directions of travel of the device **1** over the surface into radial motion. The diameter of the aperture **20** is smaller than the diameter of the sphere **16** such that the sphere **16** is retained within the device **1.**

a bottom view of the transducer elements **12** and **14** and the biasing element **18** are shown in FIG. **3** in contact with the sphere **16.** The transducer elements **12** and **14** are comprised respectively of rotatable shafts **32** and **34** which are rotatably supported on the support plane **8** by means of bearing elements **36.** The rotatable shafts **32** and **34** contact the sphere **16** at points located approximately 90° from the contact loci of the sphere **16** and the supporting surfaces. This latter feature is more clearly shown in the front view, FIG. **4,** of the arrangement shown in FIG. **3.**

Additionally, the rotatable shafts **32** and **34** contact the sphere **16** at points on the sphere approximately 90° from each other. To maintain the desired physical relationships between the shafts **32** and **34** and the sphere **16,** the shafts **32** and **34** mounted at right angles to each other and located substantially parallel to the supporting surface over which the device **1** is to be transported.

The biasing element **18** constrains the sphere against the shafts **32** and **34** to ensure that the radial rotation of the sphere **16** is translated into Cartesian coordinates of motion respective to the resulting rotation of the shafts **32** and **34.** The biasing element **18** is comprised of a wheel bearing **40** which is mounted on an axle **41** which pivots about a stem **42** mounted on the support plane **8.** The bearing **40** is biased against the sphere **16** by means of a spring **44** which is anchored to stems **46** to direct pressure on the axle **41** in the direction of the sphere **16.** The wheel bearing **40** is rotatably mounted on the axle **41** so that there is no interference with the rotation of the sphere **16.** The contact of the bearing **40** with the sphere **16** is at a position on the sphere **16** 90° from the contact loci of the sphere **16** and its supporting surface, opposite from the position of shaft contact with the sphere **16,** and approximately equal distance therefrom. The axle **41** is disposed to pivot through the plane of the shafts **32** and **34** to maintain the contact surface of the bearing **40** tangential to the surface of the sphere **16.**

Encoder disks **50** and **52** are fixed respectively on ends of the shafts **32** and **34** by means of screws **54** and **55** and sleeves **57** and **58.** The encoder disks **50** and **52** are such as described in U.S. Pat. No. 3,541,541 to convert the rotation of the shafts **32** and **34** to *x* and *y* electrical signals.

As shown in FIG. **4,** the sphere **16** is constrained in the direction opposite the supporting surface by means of a roller **60** which is spring biased by a spring **62** to contact the sphere **16** at a position off-set from a polar position defined on the surface of the sphere **16** by an axis through the center of the sphere **16** and its point of contact with its supporting surface. The roller **60** and the spring **62** are mounted relative to each other and to a section of the housing **2** as shown in FIG. **5.**

In FIG. **5**(*a*), a top view of the assembly consisting of the roller **60** and the spring **62** is shown. The roller **60** is mounted within a recess in a retainer **64** by means of a shaft **66.** The retainer **64** is mounted within the inner race of a bearing **68** which in turn is disposed in a section of the housing **2** above the upper surface of the sphere **16** as shown in FIG. **5**(*b*) to provide the desired off-set. The spring **16** is, in fact, biased in contact against the upper surface of the bearing **68,** which in turn biases the roller **60** against the surface of the sphere **16.** The spring **16** is a leaf spring which provides sufficient force to retain the bearing **68** within the channel provided in the fixed section of housing **2** and yet allow the bearing **68** to move sufficiently in the vertical direction to avoid damaging shock from the movement of the sphere **16** to be imparted to the roller **60.**

The off-set of the roller **60** from the polar position on the sphere **16** prevents any skidding of the sphere **16** which would otherwise result. Such an off-set of the roller **60** mounted within the bearing **68** provides a caster-like movement of the roller **60** as the sphere **16** rotates. The constraint thus provided in the vertical direction for the sphere **16** allows for smooth action and rotation of the sphere **16** for the optimum conversion of directional information through to the rotational shafts **32** and **34.**

About the periphery of the aperture **20** of the support plane **8** is located a washer **72** which is biased against the surface of the sphere **16** by means of a wave-spring washer **74** disposed within a recess in the support plane **8.** The washer **72** therefore serves to provide a seal between the plane **8** and the sphere **16** to keep dirt from entering the device **1** in that dirt is removed from the sphere **16** as it rotates. The action of the wave-spring washer **74** also serves to provide a cushion for the sphere **16** to protect the sphere **16** from any excessive pressures, such as from the device **1** being dropped. In FIG. **5**(*c*), the washer **72** and **74** are shown.

Obviously, many modifications of the present invention are possible in light of the above teaching. It is therefore to be understood that, in the scope of the appended claims, the invention may be practiced other than as specifically described.

What is claimed is:

1. Apparatus for indicating movement over a surface comprising:

a housing having an apertured base member,

a sphere loosely supported by said housing such that said sphere can have universal rotation and such that a portion of said sphere extends through said aperture in said base member, contact between said sphere and the surface providing rotation of said sphere indicative of movement of said housing with respect to the surface,

a pair of rotatable members each supported by said housing, each of said rotatable members being adapted to rotate about a longitudinal axis thereof, the axes of rotation of said rotatable members being substantially perpendicular to each other, each of said rotatable members being in frictional abutment with said sphere such that each of said rotatable members rotates as a function of a component of the rotation of said sphere,

transducer means responsive to rotation of each of said rotatable members for delivering signals indicative of the movement and position of said housing, and

rotatable means for urging said sphere toward said base member, said rotatable means contacting said sphere at a position off-set from a polar position on the surface of said sphere defined by an axis through the center of said sphere and the point of contact of said sphere with the surface.

2. The apparatus of claim **1** wherein a non-planar member surrounds said aperture in said base member to provide a seal between said base member and the portion of said sphere extending through said aperture in said base member.

3. Position indicator apparatus for a display monitor whereby the display is alterable in accordance with signals delivered which indicate positions on said display and changes to be made therein, said apparatus being movable over a surface to provide position indications corresponding to positions on said display, comprising:

a housing having an apertured base member,

a sphere loosely supported by said housing such that said sphere can have universal rotation and such that a portion of said sphere extends through said aperture in said base member, contact between said sphere and the surface providing for rotation of said sphere indicative of movement of said housing with respect to the surface,

a pair of rotatable members each supported by said housing, each of said members being adapted to rotate about a longitudinal axis thereof, the axis of rotation of said rotatable members being substantially perpendicular to each other, each of said rotatable members being in frictional abutment with said sphere such that each of said rotatable members rotates as a function of a component of the rotation of said sphere,

transducer means responsive to rotation of each of said rotatable members for delivering signals to said monitor indicative of the movement and position of said housing, and

rotatable means for urging said sphere toward said base member, said rotatable means contacting said sphere at a position off-set from a polar position on the surface of said sphere defined by an axis through the center of said sphere and the point of contact of said sphere with the surface.

4. The position indicator apparatus of claim **3** wherein a non-planar member surrounds said aperture in said base member to provide a seal between said base member and the portion of said sphere extending through said aperture in said base member.

5. Apparatus for indicating movement over a surface comprising:

a housing having an apertured base member,

a sphere loosely supported by said housing such that said sphere can have universal rotation and such that a portion of said sphere extends through said aperture in said base member, contact between said sphere and the surface providing rotation of said sphere indicative of movement of said housing with respect to the surface,

a pair of rotatable members each supported by said housing, each of said rotatable members being adapted to rotate about a longitudinal axis thereof, the axes of rotation of said rotatable members being substantially perpendicular to each other, each of said rotatable members being in frictional abutment with said sphere such that each of said rotatable members rotates as a function of a component of the rotation of said sphere,

transducer means responsive to rotation of each of said rotatable members for delivering signals indicative of the movement and position of said housing,

rotatable means for urging said sphere toward said base member, said rotatable means contacting said sphere at a position off-set from a polar position on the surface of said sphere defined by an axis through the center of said sphere and the point of contact of said sphere with the surface, and

a non-planar member surrounds said aperture in said base member to provide a seal between said base member and the portion of said sphere extending through said aperture in said base member.

* * * * *